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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/613,580	07/02/2003	David Henry Gurr	129159	5508

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EXAMINER	
KISH, JAMES M	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/613,580	GURR ET AL.	
	Examiner	Art Unit	
	JAMES KISH	3737	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *5/19/08*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20,25,26 and 28-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20,25,26 and 28-31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Allowable Subject Matter

The indicated allowability of original claims 22 and 24 is withdrawn in view of the newly discovered reference(s) to Goto (US Patent Pub. No. 2001/0041819). Rejections based on the newly cited reference(s) follow.

Response to Arguments

Applicant's arguments with respect to the claims have been considered but are moot in view of the new ground(s) of rejection.

Claim Objections

Claim 3 is objected to under 37 CFR 1.75 as being a substantial duplicate of claim 2. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

Claims 25, 28 and 29 objected to because of the following informalities:

In both claims 25 and 29, the first line after “form a nested loop, the nested loop comprising” provides encoding the datasets m_1 times, where the next step refers to this variable as n_1.

Claim 28 appears to contain several grammatical errors and is confusing because of these. For example, "a receiver for receiving magnetic field magnetic resonance signals…"

Appropriate correction is required.

Claim Rejections - 35 USC § 101

The following is a quotation of 35 U.S.C. 101:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 1-20, 25,26 and 29-31are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. The claims are directed towards data processing and computer program per se which does not constitute a statutory process, machine, manufacture, or composition of matter. Furthermore, the claims fail to tie the process to another statutory class or identify an apparatus that accomplishes the method steps. Furthermore, these claims fail to provide a useful, concrete and tangible result.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-7, 9-10, 12, 16-19, 26 and 28-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsui et al. (US Patent No. 4,727,325) in view of King (US Patent No. 5,892,358), further in view of Miyazaki et al. (US Patent No. 6,068,595), and further in view of Goto (US Patent Pub. No. 2001/0041819). Matsui discloses an NMR imaging method using rotating field gradients. The gradients (see Figure 6) produce a spiral sampling of k-space as can be seen in any of Figures 5B, 8 or 10. The system includes a sequencer under the control of a central processing unit (column 4, lines 13-15). Several reconstruction methods are discussed, such as Fourier transforming information on a diameter and then subjecting that data to back projection (column 3, lines 46-49), or data from circularly sampled data is re-gridded to rectangular coordinates by 2D interpolation, and undergoes 2D Fourier transformation, to obtain a desired image (column 6, lines 28-50). Also see column 9, line 55 through column 11, line 11 for disclosure on back-projection. Also disclosed is the fact that the frequency

coordinates are represented as a function of both sine and cosine functions (column 12, lines 62-68). The disclosure of Matsui is not limited to 2D and can be extended to 3D imaging, as stated at column 15, lines 35-39). While Matsui teaches a spiral trajectory, Matsui does not use an elliptical sampling of k-space.

King teaches a set of data samples acquired during an acquisition period, each of the data samples corresponding to a sampling point on the anisotropic spiral trajectory, the spacing between adjacent sampling points measured along the first k-space axis is substantially less than the spacing there between measured along the second k-space axis (*see* Abstract). This is illustrated in Figure 7 and described more in detail at column 6, lines 12-61. It would have been obvious at the time the invention was made to use an anisotropic, or elliptical, trajectory as taught by King in the system of Matsui (or any other MR system utilizing a spiral trajectory) because the anisotropic field of view can be employed to improve spiral scan image quality (column 6, lines 14-15).

Regarding the claim language stating “forming datasets representative of an object by frequency encoding in a Z-direction of a k-space,” the Examiner reiterates the Advisory Action dated December 27, 2007. In the Advisory Action the Examiner stated, "the Cartesian coordinate system is an arbitrary labeling of the axes.” In support of this Official Notice the Examiner cites column 5, lines 2-5 of Miyazaki where it is stated, “Thus, directions in which a slice selective magnetic field gradient G_S, a phase-encoding magnetic field gradient G_E, and a readout (frequency-encoding) magnetic field gradient G_R are applied can be specified and changed arbitrarily.”

Regarding forming a nested loop and the specific equations representing each datum, paragraph 47 of the current application's own specification states, "It is noted that datasets can be sampled on to planes 82, 94, 96 and 98 by a variety of methods including simple phase encoding as described above, Echo-planar imaging (EPI), and spiral imaging to generate the MR signals representative of patient 135." Therefore, the specific equation claimed and the nested loop does not hold patentable criticality to the claimed invention. The above cited references all teach either one of EPI or spiral imaging. Furthermore, Examiner notes the addition of Goto for teaching methods of magnetic resonance imaging incorporating pulse sequences which are repeated 64 to 512 times. Every time they are repeated, the phase encode gradient GP is altered to carry out phase encoding in a different way (paragraph 64). While discussed with reference to gradient echo methods, other appropriate techniques include EPI (paragraph 70). It would have been obvious to one of skill in the art to change the phase encoding gradient with each iteration in order to properly fill k-space and acquire MR signals.

Regarding claims 16 and 18, Miyazaki teaches to carry out synthesis of image data. One example of said synthesis is addition in which reconstructed image data items of a plurality of frames are added up pixel by pixel or MIP (column 5, line 56 through column 6, line 7). It would have been obvious to one having ordinary skill in the art at the time the invention was made to use MIP, as taught by Miyazaki, in the method of Matsui in order to create an image with excellent depiction ability without the loss of information of directivities (see Abstract).

Claims 1-7 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heid (US Patent No. 6,486,670) in view of King (US Patent No. 5,892,358), further in view of Miyazaki et al. (US Patent No. 6,068,595), and further in view of Goto (US Patent Pub. No. 2001/0041819). Heid discloses a method for imaging with NMR wherein the k-space sampling proceeds along a curved path. The data is sampled on to a spiral trajectory in k-space and is then interpolated for placement onto a rectangular coordinate system. The method applies to both 2D and 3D imaging. See the section entitled “Summary of the Invention.” The method uses spiral or echo-planar imaging techniques (column 2, lines 55-62). Also see column 3, line 34 through column 4, line 5. While Heid teaches a spiral trajectory, Heid does not use an elliptical sampling of k-space.

King teaches a set of data samples acquired during an acquisition period, each of the data samples corresponding to a sampling point on the anisotropic spiral trajectory, the spacing between adjacent sampling points measured along the first k-space axis is substantially less than the spacing there between measured along the second k-space axis (*see* Abstract). This is illustrated in Figure 7 and described more in detail at column 6, lines 12-61. It would have been obvious at the time the invention was made to use an anisotropic, or elliptical, trajectory as taught by King in the system of Heid (or any other MR system utilizing a spiral trajectory) because the anisotropic field of view can be employed to improve spiral scan image quality (column 6, lines 14-15).

Regarding the claim language stating “forming datasets representative of an object by frequency encoding in a Z-direction of a k-space,” the Examiner reiterates the Advisory Action dated December 27, 2007. In the Advisory Action the Examiner stated, "the Cartesian coordinate system is an arbitrary labeling of the axes.” In support of this Official Notice the Examiner cites column 5, lines 2-5 of Miyazaki where it is stated, “Thus, directions in which a slice selective magnetic field gradient G_S, a phase-encoding magnetic field gradient G_E, and a readout (frequency-encoding) magnetic field gradient G_R are applied can be specified and changed arbitrarily.”

Regarding forming a nested loop and the specific equations representing each datum, paragraph 47 of the current application’s own specification states, “It is noted that datasets can be sampled on to planes 82, 94, 96 and 98 by a variety of methods including simple phase encoding as described above, Echo-planar imaging (EPI), and spiral imaging to generate the MR signals representative of patient 135.” Therefore, the specific equation claimed and the nested loop does not hold patentable criticality to the claimed invention. The above cited references all teach either one of EPI or spiral imaging. Furthermore, Examiner notes the addition of Goto for teaching methods of magnetic resonance imaging incorporating pulse sequences which are repeated 64 to 512 times. Every time they are repeated, the phase encode gradient GP is altered to carry out phase encoding in a different way (paragraph 64). While discussed with reference to gradient echo methods, other appropriate techniques include EPI (paragraph 70). It would have been obvious to one of skill in the art to change the

phase encoding gradient with each iteration in order to properly fill k-space and acquire MR signals.

Claims 1-7, 9-10, 14, 19-20 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brittain (US Patent No. 6,794,869) in view of King (US Patent No. 5,892,358), further in view of Miyazaki et al. (US Patent No. 6,068,595), and further in view of Goto (US Patent Pub. No. 2001/0041819). Brittain discloses a system and method for acquiring data to reconstruct MRI across a large FOV with reduced acquisition time. The phase encoding gradients for a 3D acquisition could also be positioned on concentric circles, in the shape of a spiral, in rays from the center of k-space, or in any other pattern. If a non-uniform placement is utilized, the data would be gridded in the transverse dimension(s) during reconstruction (column 13, lines 18-26). However, any 3D k-space trajectory that is uniform in the direction of table motion can be used, including groups of planes with relative angles (column 8, lines 15-34). See column 7, lines 16-29 for a written description of Figure 5. Figure 5 demonstrates a reconstruction algorithm comprising Fourier transformation in the z-direction, followed by gridding of the data in k_x-k_y and finally Fourier transformation in the x and y-directions. The method provides stacks of images along the z-axis (column 5, lines 49-67). See column 13, lines 54-67 for discussion of contrast agents. While Brittain teaches a spiral trajectory, Brittain does not use an elliptical sampling of k-space.

King teaches a set of data samples acquired during an acquisition period, each of the data samples corresponding to a sampling point on the anisotropic spiral

trajectory, the spacing between adjacent sampling points measured along the first k-space axis is substantially less than the spacing there between measured along the second k-space axis (*see* Abstract). This is illustrated in Figure 7 and described more in detail at column 6, lines 12-61. It would have been obvious at the time the invention was made to use an anisotropic, or elliptical, trajectory as taught by King in the system of Brittain (or any other MR system utilizing a spiral trajectory) because the anisotropic field of view can be employed to improve spiral scan image quality (column 6, lines 14-15).

Regarding the claim language stating “forming datasets representative of an object by frequency encoding in a Z-direction of a k-space,” the Examiner reiterates the Advisory Action dated December 27, 2007. In the Advisory Action the Examiner stated, "the Cartesian coordinate system is an arbitrary labeling of the axes.” In support of this Official Notice the Examiner cites column 5, lines 2-5 of Miyazaki where it is stated, “Thus, directions in which a slice selective magnetic field gradient G_S, a phase-encoding magnetic field gradient G_E, and a readout (frequency-encoding) magnetic field gradient G_R are applied can be specified and changed arbitrarily.”

Regarding forming a nested loop and the specific equations representing each datum, paragraph 47 of the current application’s own specification states, “It is noted that datasets can be sampled on to planes 82, 94, 96 and 98 by a variety of methods including simple phase encoding as described above, Echo-planar imaging (EPI), and spiral imaging to generate the MR signals representative of patient 135.” Therefore, the specific equation claimed and the nested loop does not hold patentable criticality to the

claimed invention. The above cited references all teach either one of EPI or spiral imaging. Furthermore, Examiner notes the addition of Goto for teaching methods of magnetic resonance imaging incorporating pulse sequences which are repeated 64 to 512 times. Every time they are repeated, the phase encode gradient GP is altered to carry out phase encoding in a different way (paragraph 64). While discussed with reference to gradient echo methods, other appropriate techniques include EPI (paragraph 70). It would have been obvious to one of skill in the art to change the phase encoding gradient with each iteration in order to properly fill k-space and acquire MR signals.

Claims 1-9, 11, 13 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mertelmeier et al. (US Patent App. No. 2002/0175683) in view of King (US Patent No. 5,892,358), further in view of Miyazaki et al. (US Patent No. 6,068,595), and further in view of Goto (US Patent Pub. No. 2001/0041819). Mertelmeier discloses a method for fast acquisition of a MRI. The Fourier space is scanned with a raster of polar coordinates. In one reconstruction method as described, the received MR signals are subjected to a 1D Fourier transformation and are then reconstructed by means of a filtered back-projection (paragraph 5). The discussions of 2D also apply to 3D, as stated in paragraph 6. Regarding projection angles, see paragraph 36. Also see paragraphs 15-17. While Mertelmeier teaches a spiral trajectory, Mertelmeier does not use an elliptical sampling of k-space.

King teaches a set of data samples acquired during an acquisition period, each of the data samples corresponding to a sampling point on the anisotropic spiral trajectory, the spacing between adjacent sampling points measured along the first k-space axis is substantially less than the spacing there between measured along the second k-space axis (*see* Abstract). This is illustrated in Figure 7 and described more in detail at column 6, lines 12-61. It would have been obvious at the time the invention was made to use an anisotropic, or elliptical, trajectory as taught by King in the system of Mertelmeier (or any other MR system utilizing a spiral trajectory) because the anisotropic field of view can be employed to improve spiral scan image quality (column 6, lines 14-15).

Regarding the claim language stating "forming datasets representative of an object by frequency encoding in a Z-direction of a k-space," the Examiner reiterates the Advisory Action dated December 27, 2007. In the Advisory Action the Examiner stated, "the Cartesian coordinate system is an arbitrary labeling of the axes." In support of this Official Notice the Examiner cites column 5, lines 2-5 of Miyazaki where it is stated, "Thus, directions in which a slice selective magnetic field gradient G_S, a phase-encoding magnetic field gradient G_E, and a readout (frequency-encoding) magnetic field gradient G_R are applied can be specified and changed arbitrarily."

Regarding forming a nested loop and the specific equations representing each datum, paragraph 47 of the current application's own specification states, "It is noted that datasets can be sampled on to planes 82, 94, 96 and 98 by a variety of methods including simple phase encoding as described above, Echo-planar imaging (EPI), and

spiral imaging to generate the MR signals representative of patient 135." Therefore, the specific equation claimed and the nested loop does not hold patentable criticality to the claimed invention. The above cited references all teach either one of EPI or spiral imaging. Furthermore, Examiner notes the addition of Goto for teaching methods of magnetic resonance imaging incorporating pulse sequences which are repeated 64 to 512 times. Every time they are repeated, the phase encode gradient GP is altered to carry out phase encoding in a different way (paragraph 64). While discussed with reference to gradient echo methods, other appropriate techniques include EPI (paragraph 70). It would have been obvious to one of skill in the art to change the phase encoding gradient with each iteration in order to properly fill k-space and acquire MR signals.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAMES KISH whose telephone number is (571)272-5554. The examiner can normally be reached on 8:30 - 5:00 ~ Mon. - Fri..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Casler can be reached on 571-272-4956. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Ruth S. Smith/
Primary Examiner, Art Unit 3737

JMK